PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project	
Captive Rearing Initiative for Salmon River Chinook Salmon	
BPA project number	**9700100**
Contract renewal date (mm/yyyy)	**10/1999**
Multiple actions? (indicate Yes or No)	**Yes**
Business name of agency, institution or organization requesting funding	
Idaho Department of Fish and Game	
Business acronym (if appropriate)	**IDFG**
Proposal contact person or principal investigator:	
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NPPC Program Measure Number(s) which this project addresses	
7.4D.2, 7.4E	
FWS/NMFS Biological Opinion Number(s) which this project addresses	
Permitted under ESA Section 10	
Other planning document references	
1) Chapter 7 (Artificial Production) of the Draft Snake River Salmon Recovery Plan (Schmitten et al. 1997) discusses using hatchery intervention techniques to maintain or boost naturally spawning populations. This discussion includes numerous references to the maintenance of "captive reserves" for some populations. Strategies A, B, and C (pages 106 and 107 in Schmitten et al. 1997) specifically reference the use of artificial reserves or captive populations to accomplish spring/summer chinook salmon objectives identified in the plan. **2) NMFS T.M. #NWFSC-2 Pacific Salmon and Artificial Propagation Under the Endangered Species Act. Discussion of the utility of hatchery conservation programs under the Endangered Species Act. The memorandum also states the viability of the comprehensive Snake River spring/summer chinook salmon ESU is dependent on the continued existence of the population units that comprise it.** **3) NPPC Return to the River. Chapter 8, Conclusion 10 under Hatcheries identifies hatchery programs for severely depressed stocks important sources of genetic information. Evaluations called or by the ISG are essential and active components of this program.** **4) CPFWA FY1999 Draft Annual Implementation Work Plan - Pages 152-154.**	

Short description
Develop captive rearing techniques for chinook salmon and evaluate the success and utility of captive rearing for maintaining stock structure and minimum number of adult spawners in three drainages.
Target species
Snake River spring/summer chinook salmon

Section 2. Sorting and evaluation

Subbasin
Salmon River

Evaluation Process Sort

CBFWA caucus		CBFWA eval. process		ISRP project type	
X one or more caucus		If your project fits either of these processes, X one or both		X one or more categories	
X	Anadromous fish	X	Multi-year (milestone-based evaluation)		Watershed councils/model watersheds
	Resident Fish		Watershed project eval.		Information dissemination
	Wildlife				Operation & maintenance
					New construction
				X	Research & monitoring
					Implementation & mgmt
					Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
9606700	Manchester Captive Brood Stock O&M	Saltwater rearing at NMFS Manchester, WA facility for greater

		than one-half of fish in program.
9305600	Assessment of Captive Brood Stock Techniques	NMFS guidance for the refinement and use of captive brood stock technology for Pacific salmon.
8909600	Genetic Monitoring and Evaluation of Snake River Salmon and Steelhead	NMFS genetic analysis of brood stock and wild chinook salmon.
9107200	Redfish Lake Sockeye Salmon Captive Brood Stock Program	IDFG program at Eagle Fish Hatchery to establish captive brood stocks of Redfish Lake sockeye salmon.
9604400	Grande Ronde Basin Spring Chinook Captive Broodstock Program	ODFW captive broodstock program for three stocks of spring chinook salmon in the Grande Ronde River basin.

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1995	Collection of brood year 1994 spring chinook salmon parr from the Lemhi River, East Fork Salmon River, and West Fork Yankee Fork Salmon River.	yes, juveniles were collected for the captive rearing program to decrease smolt to adult mortality
1996	Collection of brood year 1995 spring chinook salmon parr from the Lemhi River.	yes, juveniles were collected for the captive rearing program to decrease smolt to adult mortality
1996	Less than 6% male maturation in brood year 1994 stocks (age 2).	yes, maintained natural maturation schedule
1997	Less than 30% male maturation in brood year 1994 stocks (age 3).	yes, maintained natural maturation schedule
1997	Successful outplanting of up to four, brood year 1994, three-year-old male chinook salmon to source streams. Movement and behavior documented.	yes, supplemented natural spawning population
1997	Milt from brood year 1994 East Fork Salmon River and West Fork Yankee Fork Salmon River male chinook salmon cryopreserved.	N/A, management action to maintain future conservation options
1997	Less than 6% male maturation in brood year	yes, maintained natural maturation

	1995 Lemhi River chinook salmon (age 2).	schedule
1997	Collection of brood year 1996 spring chinook salmon parr from the Lemhi River and West Fork Yankee Fork Salmon River.	yes, juveniles were collected for the captive rearing program to decrease smolt to adult mortality
1998	Age 4 maturation in East Fork Salmon River (59%), West Fork Yankee Fork Salmon River (93%), and Lemhi River (74%) brood year 1994 stocks.	N/A, management action to maintain future conservation options
1998	Less than 26% male maturation in brood year 1995 Lemhi River stock (age 3).	N/A, management action to maintain future conservation options
1998	Less than 5% male maturation in brood year 1996 stocks (age 2).	N/A, management action to maintain future conservation options
1998	Successful outplanting of maturing, brood year 1994 (four-year-old) and brood year 1995 (three-year-old Lemhi River males) chinook salmon to source streams.	yes, supplemented natural spawning population
1998	Documentation of 25, and 4 redds (constructed by captive program chinook) in the Lemhi River system and West Fork Yankee Fork Salmon River, respectively.	yes, supplemented natural spawning population
1998	Milt from brood year 1994, 1995, and 1996 captive chinook cryopreserved.	N/A, management action to maintain future conservation options
1998	Successful hatchery pilot investigation of gamete quality and survival to the eyed-egg stage for spawn products produced by Lemhi River (brood year 1994, 1995), East Fork Salmon River (brood year 1994), and West Fork Yankee Fork Salmon River (brood year 1994) stocks.	yes, documentented viable gamete production from captively reared chinook salmon
1998	Collection of brood year 1997 spring chinook salmon parr from the Lemhi River and West Fork Yankee Fork Salmon River.	yes, juveniles were collected for the captive rearing program to decrease smolt to adult mortality
1998		

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Produce captive-reared adult chinook salmon with morphological, physiological, and behavioral characteristics similar to naturally produced fish.	a	Develop facilities and propagation techniques to attain objective.
		b	Collect fish/eggs from three stocks for the captive rearing program.

Obj 1,2,3	Objective	Task a,b,c	Task
		c	Document propagation protocols including: formulation of feed used, feed rates, rearing environment and protocols, handling frequency, fish health management, and transportation methods.
		d	Monitor growth and maturation of captive-reared fish.
		e	PIT tag and visual implant tag all fish to facilitate population isolation and tracking during captive culture.
		f	Cryopreserve milt from male captive chinook salmon as needed to preserve future options.
2	Evaluate spawning behavior and success of out planted (captive-reared) adults.	a	Tag adults with externally visible tags prior to out planting, and radio-tag a reasonable number of fish for field tracking.
		b	Monitor movement, distribution, behavior, and spawning success of out planted fish.
		c	Identify and document locations of radio-tagged fish daily.
		d	Map redd locations and note observed spawner pairings.
		e	Perform snorkel surveys to estimate parr production.
		f	Conduct pilot evaluations of gamete quality and survival to the eyed-egg stage.
3	Assess population viability and develop conservation management plan.	a	Assess status of 28 spring/summer chinook stocks in Idaho.
		b	Identify at risk spring/summer chinook stocks in Idaho.
		c	Initiate NWPPC three step review process and complete step one.
		d	Personnel and fish culture facility expansion feasibility study
4	Information/Technology transfer.	a	Participate in Technical Oversight Committee process.
		b	Develop and provide IDFG, other agency, and Tribal personnel with

Obj 1,2,3	Objective	Task a,b,c	Task
			current, concise accounts of project activities.

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	08/1995	12/2005	increased smolt - adult survival	yes	50
2	06/1997	12/2005	supplement naturally spawning populations	yes	25
3	10/1999	9/2000	none	yes	20
4	08/1995	12/2005	none		5
				Total	100

Schedule constraints
No known constraints.
Completion date
2005 is the expected end date for the current demonstration project. The project may continue if the demonstration process is successful and leads to a recovery program.

Section 5. Budget

FY99 project budget (BPA obligated):	**$145,003**

FY2000 budget by line item

Item	Note	% of total	FY2000 ($)
Personnel	2.83 FTE permanent, 2.5 FTE temporary	25.0	136,807
Fringe benefits		8.4	46,010
Supplies, materials, non-expendable property		3.8	20,710
Operations & maintenance		16.4	89,520
Capital acquisitions or improvements (e.g. land, buildings, major equip.)	Facility maintenance at Eagle Hatchery; fish transport vehicle replacement	9.1	49,500
NEPA costs			
Construction-related support			

PIT tags	# of tags: 1000	0.005	2,900
Travel		1.9	10,250
Indirect costs	23% of costs, excluding capital	16.6	90,688
Subcontractor			
Other	Population Status/Viability Assessment and Engineering Assessment for future program implementation and site development	18.3	100,000
TOTAL BPA REQUESTED BUDGET			546,385

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
Total project cost (including BPA portion)			

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	450,000	470,000	1,500,000	1,200,000

Section 6. References

Watershed?	Reference
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	National Research Council (NRC). 1995. Science and the Endangered Species Act. National Academy Press, Washington, D.C.
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	Schmitten, R. W. Stelle, and M. Brentwood. 1997 (in review). Snake River Salmon Recovery Plan. U.S. Department of Commerce, national Oceanic and Atmospheric Administration, National Marine Fisheries Service.
	Wheeler, P. A. , and G. A. Thorgaard. 1991. Cryopreservation of rainbow trout semen in large straws. Aquaculture 93:95-100.

PART II - NARRATIVE

Section 7. Abstract

(To maintain Snake River chinook salmon metapopulation or stock structure, the within and among population variability, IDFG initiated a captive rearing program for populations at high risk of extinction. Captive rearing is a short term approach to species preservation. The primary goal of the captive rearing approach is to avoid demographic and environmental risks of cohort extinction; maintaining the genetic identity of the breeding unit is an important but secondary objective. The strategy of captive rearing is to prevent cohort collapse of the specified target populations by providing captively reared adult spawners to the natural environment, which, in turn, maintain the continuum of generation to generation smolt production. Each generation of smolts, then, provides the opportunity for population maintenance or increase should environmental conditions prove favorable for that cohort.

The goal of this project is to develop and test captive rearing techniques. Program activities are divided into two functional bodies: hatchery propagation and monitoring and evaluation (previously submitted as separate proposals – 9700100 and 9801002). Success of the program is dependent on the development of effective rearing technology and on the evaluation of post-release adult chinook salmon behavior and spawning success.

This is a demonstration project as identified in section 7.4D.2 of the Council's Fish and Wildlife program. The year 2005 is the expected end date for the current project. The project may continue if the demonstration process is successful and leads to a recovery program.)

Section 8. Project description

a. Technical and/or scientific background

(The combined counts of returning spring and summer chinook salmon to the Snake Basin were the lowest on record in 1994 (4,475) and again in 1995 (2,787). For perspective, from 1962 to 1971 an average of 148,000 adult anadromous salmonids per year crossed Ice Harbor Dam into the Snake River Basin. Most of these returnees were produced in and destined for production areas located upstream of Lower Granite Dam. The spring/summer component of the run was comprised primarily of wild fish and accounted for about 40 percent of the run, an average of 59,900 fish annually. In contrast, 3,915 adult spring and summer chinook salmon passed upstream of Lower Granite Dam in 1994, including 1,517 and 305 naturally produced springs and summers, respectively.

IDFG's long-term objective for salmon management is to maintain Snake River salmon populations at levels that will provide sustainable harvest (IDFG 1992). Restoring the number of returning chinook salmon to historic levels is a prerequisite to this condition. Artificial propagation of spring and summer chinook salmon in the Salmon River basin, through Lower Snake River Compensation Plan (LSRCP) and Idaho Power Company hatcheries, was initiated to compensate for lost production and productivity caused by the construction and operation of private and federal hydroelectric facilities in the Snake River. The mitigation approach was to trap, spawn, and rear a portion of the historically productive local brood stock to produce a large number of smolts (Bowles 1993). When chinook salmon trapping began in 1981 as part of the LSRCP, it was assumed that enough chinook salmon adults would return for harvest and continued hatchery production needs. It was also assumed that hatchery programs would not negatively impact the productivity or genetic viability of target or other populations, and that natural populations would remain self-sustaining even with hydropower dams in place. In reality, productivity (survival rates) of wild Snake River chinook salmon declined abruptly with completion of the federal hydroelectric system by the mid-1970's (Petrosky and Schaller 1994). Survival rates used in the hatchery mitigation program models were substantially overestimated. Hence, hatchery programs have been unable to mitigate for the dams or stem the decline of target populations, and numbers of naturally produced salmon declined at various rates throughout the Snake River Basin. Spring/summer chinook salmon returns have been insufficient to meet artificial and natural smolt and adult production predictions, much less provide a consistent harvestable surplus of adults.

The only way to prevent further decline and secure eventual recovery of Snake River stocks is to provide historical levels of survival in the migration corridor. Pending changes in the mainstem hydroelectric system, our immediate challenge becomes one of preserving the existing metapopulation structure of Snake River chinook salmon, so future recovery actions are possible. The listed Snake River spring/summer chinook salmon evolutionary significant unit (ESU) consists of 38 subpopulations (i.e. breeding units or stocks), 28 of which exist in the Salmon River Drainage (NMFS 1995). Preserving the current stock or metapopulation structure is consistent with the pre-decisional Snake River Salmon Recovery Plan (Schmitten et al. 1997, in review), and also supports the Council's goal of maintaining biological diversity while doubling salmon and steelhead runs as identified in their Fish and Wildlife Program (FWP). Metapopulation structure (or biodiversity) can be maintained by preventing local or demographic extinctions.

The IDFG initiated a captive rearing approach for populations at high risk of extinction to maintain metapopulation structure. Captive rearing is a short term approach to species preservation. The main goal of the captive rearing approach is to avoid demographic and environmental risks of cohort extinction; maintaining the genetic identity of the breeding unit is an important but secondary objective. The strategy of captive rearing is to prevent cohort collapse of the specified target populations by providing captively reared adult spawners to the natural environment, which in turn, maintain the continuum of generation to generation smolt production. Each generation of smolts, then, provides the opportunity for population maintenance or increase should environmental conditions prove favorable for that cohort. The issue paper "Recovery Plan Recommendations for Hatchery Production" (IDFG 1994), provides the background, objectives, options, and approach relative to the captive rearing concept.

The captive rearing approach was developed primarily as a way to maximize the number of breeding units that could be addressed while minimizing intervention impacts. Under these guidelines we collect only enough juveniles from the target populations to provide what we feel are adequate spawners, about 20, to meet our demographic spawner goals. (According to members of the StanleyBasin Sockeye Technical Oversight Committee, it is not unreasonable to assume that 20 fish could encompass 95 percent of the genetic diversity of the population.) The appropriate number of juveniles to collect remains somewhat speculative at this time because of the uncertainty associated with the ability of the captive rearing approach to produce adults with desired characteristics for release into the wild (Fleming and Gross 1992, 1993: Joyce et al. 1993: Flagg and Mahnken 1995). Juveniles would be collected each year from cohorts of low resiliency populations, those not expected to return at least 10 spawning pair to their respective spawning areas. In order for this approach to provide the desired outcome we must be able to produce an adequate number of adults with the proper morphological, physiological, and behavioral attributes to successfully spawn and produce viable offspring in their native habitats. The successful evaluation of the captive rearing approach would require the synchronous development of successful propagation techniques while the fish are in captivity.

Little scientific information regarding captive propagation techniques for Pacific Salmonids was available at the inception of this program. This lack of information was also acknowledged in the Council's FWP measure 7.4d.1, calling for a scoping study to identify captive broodstock research needs. To address measure 7.4d.1, Flagg and Mahnken (1995) completed a review of the status of captive broodstock technology.

Measure 7.4d.2 of the FWP called for funding captive broodstock demonstration projects. Following Flagg and Mahnken's (1995) work and to address the need identified in Measure 7.4d.2, the IDFG captive rearing program was initiated, in part, as such a demonstration project. Program objectives identify the need to develop the technology for captive propagation of chinook salmon and to monitor and evaluate captive fish during both rearing phase and post-release phases.

In addition to being considered a demonstration project for captive propagation technology, the IDFG program also addresses population dynamics and population persistence concerns. The population level concerns may be further defined as 1) maintaining a minimum number of spawners in high risk populations, and 2) maintaining metapopulation structure by preventing local extinctions. These population level concerns were addressed by identifying those populations at the highest risk of extinction.

We have prioritized population for hatchery preservation actions based on assumed relative importance to the Snake River spring/summer chinook salmon ESU, assumed retention of native population characteristics, estimated imminent extinction risk, and risk of exposure to experimental techniques. High priority populations have: 1) annual escapements of less than 20 fish; 2) adequate habitat for successful spawning and rearing; and 3) poor resiliency from the last survival bottleneck (1979-1984). An analysis of population status, history, isolation and resiliency determined that several spring and summer chinook salmon populations in the Salmon River are unlikely to remain viable beyond this current survival bottleneck (IDFG 1994).)

b. Rationale and significance to Regional Programs

(Anadromous fishery managers in the basin are increasingly faced with two disparate objectives in their management programs, increasing the numbers of fish and maintaining the genetic and biological diversity of natural populations. The Council has noted the need to balance these two needs in Section 4.1 of its FWP. The Council further notes that actions aimed at increasing fish numbers and conserving biological diversity are both important to maintaining a healthy ecosystem. In the pre decisional Snake River Salmon Recovery Plan (Schmitten et al. 1997), NMFS discusses the importance of metapopulation structure and recognizes the importance of conserving smaller local populations in their Delisting Criterion 1. Also, the National Research Council (1995) described the need of recovery plans to include the creation of multiple subpopulations to ensure population viability.

Fishery managers in the Snake River basin convened to discuss possible means of maintaining overall stock structure of the Snake River chinook population by protecting small populations or stocks at high risk of extinction. It was agreed that a form of captive propagation may be appropriate for some stocks. However, it was not known how captive propagation could be best used to ensure the continued existence of the stocks and at the same time maintain the genetic and/or biological diversity of these same stocks. Two approaches were identified: a conventional captive brood stock program and a captive rearing program. The two approaches share a similar goal, in general to maintain Snake River chinook salmon metapopulation structure, by preventing local extinctions of high risk populations. Future population rebuilding opportunities can be exercised if this goal is met.

The Snake River basin Fishery managers agreed to test the utility of each captive propagation approach (broodstock versus rearing) by implementing each strategy in a separate basin. The Oregon Department of Fish and Wildlife has initiated a captive broodstock program with brood year 1994 Grande Ronde Basin chinook salmon (BPA 9604400). The IDFG initiated the captive rearing program with brood year 1994 Salmon River Basin chinook salmon. Collectively, the two approaches aim at maintaining the entire Snake River Basin chinook salmon metapopulation structure, while investigating two forms of captive propagation and determining their future utility. A successful captive rearing program would provide in place and in kind mitigation.)

c. Relationships to other projects

(The Oregon Department of Fish and Wildlife has initiated a captive broodstock program with brood year 1994 Grande Ronde Basin chinook salmon (BPA 9604400). This program differs from the IDFG program in that it emphasizes captive broodstock rather than captive rearing methods. Collectively, both programs aim at maintaining Snake River Basin chinook salmon metapopulation structure, While investigating two forms of captive propagation and determining their future utility.

The IDFG Captive Rearing Initiative for Salmon River Chinook Salmon operates in association with the LSRCP funded Sawtooth Fish Hatchery in Stanley Idaho. Juvenile chinook collected from the Lemhi River, East Fork Salmon River, and West Fork Yankee Fork Salmon River are transferred to Sawtooth for initial holding.

Cooperative fish culture activities conducted by NMFS at Washington State locations (BPA 9606700) are an integral component of the overall program. Duplicate chinook salmon cohorts are maintained in Idaho and Washington to guard against catastrophic loss at any one facility. In addition, culture activities at the NMFS Manchester site are carried out in sea water.

Guidance for the refinement and use of captive broodstock technology for Pacific salmon is provided by NMFS and brings together information on fish husbandry techniques, genetic risks, physiology, nutrition, and pathology affecting captive broodstocks (BPA 9305600)

Genetic investigations of Idaho and regional chinook salmon populations (BPA 8909600) provide essential information to the program. Conducted by NMFS, these studies generate baseline information on the genetic variability of target subpopulations. This information is an essential part of the Regional effort presently underway to maintain Snake River Basin chinook salmon metapopulation structure.

IDFG fish propagation activities associated with the chinook salmon captive rearing initiative are conducted at the Eagle Fish Hatchery; a facility presently in use to develop sockeye salmon captive broodstocks (BPA 9107200). Although managed as separate projects, program responsibilities overlap and complement each other.)

d. Project history (for ongoing projects)

(Fiscal year 1998 was the first year this project received funding through the basin Fish and

Wildlife Program. An ESA Section 10 Report for activities from 1 January to 31 December, 1997 was submitted to the NMFS in January, 1998.

Brood Year 1994 - We collected brood year 1994 juvenile chinook salmon from three spring chinook salmon populations, Lemhi River, East Fork Salmon River, and West Fork of the Yankee Fork Salmon River in 1995 to initiate the captive rearing program. These populations had 20 or fewer redds counted in 1994 and are expected to have annual escapements of less than 20 fish during the next several years. After the fish were collected in the summer of 1995 they were transported to the IDFG Sawtooth Fish Hatchery for initial rearing.

In the spring of 1996 all fish were transferred to IDFG's Eagle Fish Hatchery. In May, 1997, approximately one-half of the fish were transferred to the NMFS Manchester Marine Laboratory for saltwater rearing. The remaining half remained in freshwater at the IDFG Eagle Fish Hatchery. In July of 1996, all fish were examined for signs of sexual maturation (precocial males). The rate of precocial male development was very low, less than six percent for each of the three stocks. This was a very positive finding as early maturity is a concern in captive propagation programs.

In July 1997 fish were again sorted to separate out maturing jacks (three-year-old males). Maturing saltwater-reared jacks were transferred back to Eagle Fish hatchery for final maturation in freshwater. Although the rate of jack maturation varied among the three stocks, it was not regarded as excessively high (less than 30% overall). No difference was found in maturation rate for fresh water or salt water rearing groups and fish health was good. In 1997, a small number of maturing jacks (up to four) from each stock were equipped with radio transmitters and outplanted to their source streams. Movement and behavior were monitored. The 1997 (jack) outplanting was considered successful. In general, the fish remained in the streams where they were released, and exhibited searching and movement patterns typical of natural origin fish. It was encouraging to observe that even though the fish had been reared almost entirely in captivity, with no opportunity for normal migration and homing behaviors, they remained within their source streams after release.

We conducted age 4 maturation sorts in July, 1998. Maturing saltwater-reared fish were transported from the NMFS Manchester site to the IDFG Eagle Fish Hatchery where they were staged with maturing freshwater groups. In September, 1998, maturing brood year 1994 and 1995 chinook salmon were outplanted to the Lemhi River system (54 age 4 females and 18 age 3 males), and the West Fork of the Yankee Fork Salmon River (35 and 9 age 4 females and males, respectively). Because of demographic risks, no adults were released to the East Fork Salmon River in 1998. Using radio telemetry, we identified approximately 25 and 4 captive fish-produced redds in the Lemhi and West Fork of the Yankee Fork Salmon River systems in 1998. Investigations of spawning variables (e.g., gamete quality, survival to eyed-egg) and comparisons between rearing strategies (saltwater/freshwater) were also conducted in 1998. Results from this work are pending. In cooperation with the Shoshone-Bannock Tribes and with approval from NMFS, eyed-eggs produced from 1998 hatchery investigations were planted in streamside incubation devices. Additional milt was cryopreserved in 1998. Immature brood year 1994 chinook salmon remain at NMFS and IDFG facilities. Age 5 maturation is expected in 1999.

Brood Year 1995 – Brood year 1995 collections were conducted only in the Lemhi River. Adult spawner numbers in the East Fork Salmon River and West Fork Yankee Fork Salmon River were too low to effectively collect juveniles from these systems. As indicated above, maturing male fish from this brood year were outplanted in 1998 with brood year 1994 Lemhi

River female chinook salmon. We cryopreserved milt from this brood in 1997 and 1998. Immature brood year 1995 Lemhi River fish remain on station at NMFS and IDFG facilities. Age 4 and 5 maturation is expected in 1999 and 2000, respectively.

Brood Year 1996 – In 1997, brood year 1996 parr were colllected from the Lemhi River, West Fork Yankee Fork Salmon River, and East Fork Salmon River. Due to low East Fork Salmon River adult escapement in 1996, only five parr were collected from that system in 1997. For all three stocks, less than five percent age 2 maturation (in males) was detected at sorting in 1998. Immature brood year 1996 fish remain in culture at NMFS and IDFG facilities. Age 3, 4, and 5 maturation is expected in 1999, 2000, and 2001, respectively.

Brood Year 1997 – Parr from the Lemhi River and West Fork Yankee Fork Salmon River were collected in 1998. Due to low East Fork Salmon River adult escapement in 1997, no parr were collected from that system in 1997. Immature brood year 1997 fish remain in culture at NMFS and IDFG facilities. Age 2, 3, 4, and 5 maturation is expected in 1999, 2000, 2001, and 2002, respectively.)

e. Proposal objectives

(Objective 1. Produce captive-reared adult chinook salmon with similar morphological, physiological, and behavioral characteristics as naturally produced fish.
Ho: Captive-reared chinook salmon will meet specific morphological, physiological, and behavioral criteria at time of outplanting.
Ha: Target criteria will not be attained or only partially attained.
Potential Products: Sexually mature adults for supplementing natural spawning populations. Adequate facilities development and propagation technology to enable the continued production of mature broodstocks. Cryopreserved milt to preserve future options.

Objective 2. Evaluate spawning behavior and success of out planted (captive-reared) adults.
Ho: Captive-reared chinook salmon will survive and successfully spawn when released back to their source streams.
Ha: Captive-reared chinook salmon are physiologically and behaviorally unable to survive and spawn in the wild.
Potential Products: Supplementing natural spawning population with captive-reared adults, enhanced natural production, recommendations for adaptive management changes to program and future program direction.

Ojective 3. Assess population viability and develop conservation management plan.
Hypothesis: No testable hypotheses.
Potential Products: Population assessment and quantification of extinction risk for 28 stocks. Conservation management plan and implementation schedule. Completion of step one of NPPC three-step review process for new production facilities.

Objective 4. Information/Technology transfer.
Hypothesis: No testable hypotheses.
Potential Products: Participation in the Chinook Salmon Captive Propagation Technical Oversight

Committee process. Preparation of annual reports to satisfy NMFS Permit 1010 reporting requirements. Preparation of annual reports of program activities to satisfy BPA reporting requirements. Professional presentations.)

f. Methods

(Captive propagation of chinook salmon is a relatively new field and because of this, the role of the Chinook Salmon Captive Propagation Technical Oversight Committee (CSCPTOC) is very important to the success of the program. The CSCPTOC provides a forum of peer review and discussion of all activities and propagation protocols associated with this program. This allows for an adaptive management approach to all phases of the program and ultimately improves program success as new and better information becomes available.

Objective 1. Produce captive-reared adult chinook salmon with morphological, physiological, and behavioral characteristics similar to naturally produced fish. The IDFG and its cooperators on the chinook captive rearing program have played the lead role in developing program methodologies, especially with respect to fish culture techniques. From the inception of the program, project personnel and regional fish culture experts have participated in workshops and planning sessions that have lead to the development of culture protocols in place today. Adaptively managed through the technical oversight committee process, culture practices remain flexible to achieve maximum program success. Routine protocols including; diet and rations, rearing densities, chemical therapeutant treatments, sample counts, marking and tagging, and frequency of handling are constantly reviewed to maintain consistency between IDFG and NMFS culture locations and achieve the best program results.

IDFG provides daily staffing for the propagation of Snake River captive chinook salmon. The fish are reared using standard fish culture practices and approved therapeutants (for an overview of standard methods see Leitritz and Lewis 1976; Piper et al. 1982; Erdahl 1994; Bromage and Roberts 1995; McDaniel et al. 1996; Pennell and Barton 1996). The fish are fed a commercial diet produced by Bioproducts (Warrenton OR). The standard diet formulation is used until fish reach approximately 75 g after which time they receive a special brood diet enhanced with natural flavors from fish and krill. Rearing tank size varies with fish age. Rearing densities, diet ration, and tank size are managed to promote optimum growth and for the attainment of program objectives and goals. Mortalities, both natural and maturation-related, are typically examined by a fish pathologist. Tissues are analyzed for common bacterial and viral pathogens. In addition, tissue samples are removed, frozen (- 80 EC), and transferred to NMFS for subsequent genetic analysis (project 8909600).

Fish are transported to and from collection locations in truck mounted, insulated tanks (typically 1,136 L capacity) with alarm and back-up oxygen systems on board. For longer duration trips (e.g., from NMFS Washington facilities to Idaho), larger capacity truck mounted tanks may be used (3,785 L and 9,463 L tanks available). IDFG obtains the appropriate permits for interstate transfer of captive chinook salmon to and from NMFS facilities.

Following maturation events, a portion of male chinook salmon, not released, may be selected as donors for milt cryopreservation. Procedures follow standard practices described by Cloud et al. (1990) and Wheeler and Thorgaard (1991). Milt is cryopreserved at the IDFG Eagle Fish Hatchery, the University of Idaho, and Washington State University. Multiple facilities are used to spread the risk of catastrophic loss associated with liquid nitrogen freezer failure.

Objective 2. Evaluate spawning behavior and success of out planted (captive-reared) adults. A final determination of actual out planting and field monitoring procedures to be used in August and September, 2000 (FY2000 period of activity) will not be made until completion of the 1999 field season. This will allow us to adaptively incorporate new knowledge and address other uncertainties that may be identified. A brief review of past out plant monitoring efforts and information is given here to provide a framework for developing the FY2000 methods.

In 1997 only sexually mature males (jacks) were available to outplant. Jacks were radio-tagged and released and post-release movement and spawning behavior were observed. Observations made in 1997 indicated that the fish would remain in the streams or locations where released and blocking fences or weirs were not needed to prevent movement out of the system. This information was important to developing 1998 monitoring plans when four-year-old males and females were available to outplant.

In 1998 we were able to release four-year-old (brood year 1994) males and females and jacks (brood year 1995). All releases contained some radio-tagged fish. Fish to be radio-tagged were randomly selected from the maturing populations, and represented fish from both freshwater and saltwater captive rearings. Radio tracking was performed at least every other day. When fish were located, positions were recorded on GPS units. If observers were able to make sight confirmation of the fish, other information was recorded. This information included stream habitat type where located, evidence of mate pairing, general health and condition of the fish, spawning behavior, evidence of redd construction/defense, and other pertinent information. Observers also made observations on the non-radio-tagged fish that were outplanted. These could be indentified by opercle tags.

In 1999 we will employ similar but more intensive efforts to observe and evaluate spawning behavior. A number of fish will be released into a weired section of a tributary to the Lemhi River. (Captive-reared fish were released into this tributary in 1998.) Additional observers will be utilized to monitor the spawning activities of individual mate-pairings. In 1998, even though we were able to observe females completing redds, assumed to contain fertilized eggs, no males had been observed paired with these females. The success of males spawning with females can be determined through near-continous observation during the spawning phase, and can be later confirmed through snorkel surveys to quantify juvenile production. Intensive snorkel surveys will be done in 1999 and 2000 to document and quantify parr production. Depending on parr numbers and stream physical characteristics, screw traps may be used to enumerate outmigrating smolts.

All proposed work will be coordinated and discussed through the CSCPTOC. Also, we work in close coordination with NMFS personnel at the Manchester Marine Laboratory, who are examining the spawning behavior of hatchery-reared and wild fish in a simulated stream environment. Observations and findings from the NMFS research are incorporated in designing our field evaluation techniques, and NMFS personnel assist in the field observations.)

g. Facilities and equipment

(Eagle Hatchery is the primary Idaho site for the chinook captive rearing program. Artesian water from five wells is currently in use. Artesian flow is augmented through the use of four separate pump/motor systems. Water temperature remains a constant 13.3^{o}C and total dissolved gas averages 100% after degassing. Water chilling capability was added in 1994. Chilled water is used for incubation and for final maturation rearing. Backup and system redundancy is in place for degassing, pumping, and power generation. Nine water level alarms are in use and linked through an emergency service operator. Additional security is provided by limiting public access and by the presence of three on-site residences occupied by IDFG hatchery personnel.

Facility layout at Eagle Hatchery remains flexible to accommodate culture activities. Several fiberglass tank sizes are used to culture chinook from pre-smolt to the adult stage including: 1) 1 m diameter semi-square tanks (0.30 m^3), 2) 2 m diameter semi-square tanks (1.42 m^3), 3) 3 m diameter circular tanks (6.50 m^3), 4) 4 m diameter semi-square tanks (8.89 m^3) and 5) 6 m diameter circular tanks (44.5 m^3). One meter tanks are used to acclimate pre-smolts to hatchery diets following collections. Two meter tanks are used to rear juveniles, by stream origin, to approximately 20 g. Three and four meter tanks are used to rear juveniles to approximately 1,000 g and to depot fish by stream origin prior to distribution to natal waters. Six-meter tanks are used to rear fish to age 3+ and 4+. Flows to all tanks are maintained at no less than 1.5 exchanges per hour. Shade covering (70%) and jump screens are used where appropriate. Tank discharge standpipes are assembled in two sections ("half pipe principal") to prevent tank dewatering when removed for tank cleaning.

Sawtooth Hatchery was completed in 1985 as part of the Lower Snake River Compensation Plan and is located on the Salmon river in the Stanley Basin. Sawtooth Hatchery personnel and facilities have been used continuously since 1995 to depot pre-smolts prior to their transfer to the Eagle Fish Hatchery. Following collection, pre-smolts are held in 2 m semi-square fiberglass tanks by stream origin. All fish rearing occurs on well water. Water temperature varies by time of year from approximately 2.5 ^{o}C in January/February to 11.1 ^{o}C in August/September. Back-up and redundancy systems are in place.

Live fish transfers occur in a variety of vehicles including customized pick-up trucks and standard fish transportation trucks. The vehicle and containers used will depend upon, among other things, the size and number of fish and the distance to be hauled. Idaho Department of Fish and Game has the following tank capacities available for use in the chinook captive rearing program; 300 gal. (1,136 L), 1000 gal. (3,785 L), and 2,500 gal. (9,463 L). All vehicles are equipped to provide the appropriate conditions (temperature, oxygen, capacity) to facilitate safe transport of fish to the specified destination. All vehicles are equipped with two-way radios or cellular phones to provide routine or emergency communications. Fish are transported by IDFG or cooperator personnel.

All equipment necessary for field stations and field observations is currently on hand. This equipment includes camp trailers, weir parts, camp tents and miscellaneous camp gear, two radio telemetry receivers, radio tags, wet suits, waders, etc. Transportation needs are sufficiently met with additional IDFG vehicles available as needed (fish transportation). Additional vehicles needed during August and September will be acquired through short-term leases. PIT tag equipment includes one self-contained tagging station and two back-up readers and antennas.

Appropriate office infrastructure exists to support the program. Adequate office and storage space is available at the Eagle Fish Hatchery. The IDFG Fish Health Laboratory is located adjacent to the Eagle Fish Hatchery and provides space for all necropsy work associated with the program. Pathology investigations are carried out, as needed, at this location. Two project personnel are assigned to the Nampa Research Office. This is a fully functional IDFG Office.

Critical linkages exist between this project and: project 9606700 for co-culture of captive chinook salmon, project 9107200 for personnel, equipment, and cost sharing between captive sockeye and chinook programs at Eagle Fish Hatchery and, project 8909600 for genetic monitoring and evaluation of captive chinook salmon.)

h. Budget

(In FY1998 and FY1999 two separate projects were funded to carry out the activities of this program (9700100 and 9801002). These two projects have been combined into one project (9700100) for FY2000 funding to simplify BPA contracting and budgeting processes. Part of the FY2000 funding increase is the result of combining these two projects. No proposal is being submitted for funding of 9801002 in FY2000. Funding for 9700100 was: FY1997 - $245,000; FY1998 - $145,000; and FY1999 - $145,000. Funding for 9801002 was: FY1998 - $78,036; and FY1999 - $88,664. Thus total budgets for this program were: FY1998 - $223,036 and FY1999 - $233,664.

The increase in the FY2000 budget is necessary to staff the project with two new personnel, facility expansion/maintenance, and planning for future facility development and program expansion. New personnel include a Senior Fishery Technician (1.0 FTE) to assist with fish culture activities at Eagle Hatchery. Also, we propose to hire a project biologist (1.0 FTE) that would have project management responsibilities in both fish culture and field evaluations activities. The project biologist would also be involved in chinook salmon population status and viability assessments and planning for future program expansion. This assessment would satisfy step 1 of the NPPC's 3-step process for review of new production programs. This review process must begin in FY2000 and be completed by the end of FY2002 so any necessary program expansion can begin by FY2003. Costs for engineering assessments of potential new culture sites are included in the FY2000 budget.

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Section 9. Key personnel

(The project Principal Investigator is Peter Hassemer, Principal Fisheries Research Biologist. He has worked for the IDFG since 1990 in fisheries management and anadromous fisheries research. His primary areas of responsibility are oversight of the Department's anadromous hatchery evaluation program, chinook salmon supplementation research, and co-management of the chinook captive rearing program. He received a B.S. (1979) and M.S. (1984) in Fisheries Science from the University of Idaho.

Program co-management and supervision of fish culture activities is provided by Paul Kline. Mr. Kline has worked for IDFG since 1992 in resident and anadromous fisheries research sub-sections. He has been affiliated with salmon recovery programs since 1993. In addition to sharing chinook captive rearing program responsibility, Mr. Kline is currently principal investigator for IDFG's sockeye salmon recovery effort. Prior to assuming management responsibility for IDFG captive propagation programs, Mr. Kline served as sockeye project Research Biologist. In this capacity, he coordinated all evaluation activities associated with *O. nerka* population monitoring, juvenile outmigrant monitoring, pre-spawn adult volitional spawning investigations, life history investigations, and kokanee fishery monitoring. He received his B.S. and M.S. in Natural Resources and Fisheries from Humboldt State University (1975, 1980). Prior to coming to IDFG, Mr. Kline worked for the United States Forest Service and for a private consulting firm in Northern California. During his years in the consulting business, Mr. Kline was lead investigator on numerous fishery habitat and population surveys of coastal salmon and steelhead systems.

Keith Johnson serves as fish pathologist and technical advisor for IDFG salmon captive propagation programs. Dr. Johnson received his B.S. (1966) from the University of Idaho, his M. S. (1968) from Montana State University and his Ph.D from Oregon State University (1975). Dr. Johnson has worked in fish culture and fish health for 24 years. Dr. Johnson is currently Fish Health Manager for IDFG. Prior to assuming this position, Dr. Johnson served as principal investigator on the Sockeye Captive Broodstock Program.

Kurtis Plaster is a Senior Fisheries Technician on this project and also is involved with IDFG's LSRCP hatchery evaluation program. He has been employed by IDFG since 1989. He has a B.S. (1991) in fisheries Resources from the University of Idaho. Mr. Plaster has been employed on several chinook salmon research projects including General Parr Monitoring, Idaho Supplementation Studies, and hatchery evaluation studies.

Brian Malaise holds the position of Assistant Hatchery Manager at the IDFG Eagle Fish Hatchery. Mr. Malaise has worked for IDFG since 1990 at several resident and anadromous state facilities. He has been associated with the sockeye program since 1996. Mr. Malaise received his B.S. in Fisheries and Wildlife Biology from Iowa State University in 1990. Prior to coming to IDFG, Mr. Malaise worked for the Iowa Department of Natural Resources.

Jeff Heindel holds the position of Fish Culturist at the IDFG Eagle Fish Hatchery. Mr. Heindel has worked for IDFG since 1991. During his seven years with IDFG, Mr. Heindel has worked at Steelhead and Chinook hatcheries as well as the State's most productive resident trout facility. He has been associated with the sockeye program since 1996. Mr. Heindel received his B.S. degree from Boise State University in 1995)

Section 10. Information/technology transfer

(Considerable local attention is drawn to project activities in the upper Salmon River Basin of Idaho. Project cooperators strive to maintain an up-to-date awareness at this local level. IDFG Sawtooth Hatchery personnel, Salmon Region personnel, and immediate project personnel make public contacts on a regular basis to discuss project-related issues. IDFG information and education and enforcement personnel address different audiences several times each year to distribute project-related information. Idaho and regional news media interview project cooperators frequently contributing to the publics' awareness of regional salmon issues.

Project cooperators meet monthly (CSCPTOC) to discuss findings and review planned activities. BPA chairs this process and develops concise meeting minutes that are available to the public. Annual reports of program activities are written and are available from the BPA library. Annual reports of program activities required by Section 10 of the Endangered Species Act are also prepared. Presentations are made at regional fish culture and fish health conferences and at meetings held by the Idaho Chapter of the American Fisheries Society.)

Congratulations!